

## **Penalized for Excellence: The Invisible Hand of Career-Track Stratification**

### **Dr. Cindy Rottmann, University of Toronto**

Cindy Rottmann is the Associate Director of Research at the Troost Institute for Leadership Education in Engineering, University of Toronto. Her research interests include engineering leadership in university and workplace settings as well as ethics and equity in engineering education.

### **Dr. Emily Moore P.Eng., University of Toronto**

Emily Moore is the Director of the Troost Institute for Leadership Education in Engineering (Troost ILead) at the University of Toronto. Emily spent 20 years as a professional engineer, first as an R&D engineer in a Fortune 500 company, and then leading innovation and technology development efforts in a major engineering firm. She is now an Associate Professor conducting research and teaching on engineering leadership.

### **Dr. Doug Reeve P.Eng., University of Toronto**

Dr. Reeve was the founding Director of the Troost Institute for Leadership Education in Engineering (ILead) (2010-2018) at the University of Toronto. After a lengthy career as a consulting engineer he made development of personal capability central to his work with engineering students, undergraduate and graduate. In 2002 he established Leaders of Tomorrow, a student leadership development program that led to the establishment of ILead, the Troost Institute for Leadership Education in Engineering, in 2010. In 2017, he was co-leader of the team that developed the OPTIONS Program (Opportunities for PhDs: Transitions, Industry Options, Networking and Skills) for engineering PhD students interested in careers outside the academy. He is a Professor in the Department of Chemical Engineering and Applied Chemistry and ILead.

### **Dr. Andrea Chan, University of Toronto**

Andrea Chan is a Research Associate at the Troost Institute for Leadership Education in Engineering | University of Toronto

### **Mr. Milan Maljkovic, University of Toronto**

Milan Maljkovic is the Assistant Director, Community of Practice at the Troost Institute for Leadership Education in Engineering at the University of Toronto. Milan has several years of experience in the power systems sector. Now, at Troost ILead, he engages with engineering organizations to bring leadership opportunities to industry professionals, as well as working with undergraduate students. Milan has a BAsC in Electrical Engineering from the University of Toronto.

### **Ms. Dimpho Radebe, University of Toronto**

Dimpho Radebe is a PhD student in Engineering Education at the University of Toronto. Her research interests include engineering culture, engineering careers in the public sector, and ethics and equity in STEM. Dimpho has several years of experience in the public and private sectors in process engineering, as well as project management and implementation. She holds a BAsC in Industrial Engineering from the University of Toronto and an MSc in Management, specializing in Operations Management, from the University of Bath.

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### **Abstract**

*Inequities persist in the engineering profession despite nearly four decades of diversity and inclusion efforts. In this paper, we propose an institutional mechanism to explain this persistence—career track stratification. When engineering educators and researchers frame engineers' careers as personal journeys, we implicitly characterize diverse promotion patterns as the product of individuals' idiosyncratic interests, values, goals and competencies, leaving ourselves open to meritocratic explanations of career mobility. In contrast, when we account for systemic inequities in organizations and society by critically examining engineers' careers in the aggregate, it is possible to gain insights into the "hidden curriculum"<sup>1</sup> of professional advancement. In this paper, we take the latter approach, adopting a critical secondary analysis of data originally collected for a project on situated workplace learning. The key contribution of our analysis is to reframe the personal choice narrative of career advancement with a structural explanation of career stratification based on Jeannie Oakes' educational tracking research, and Audre Lord's powerful notion of "dominant fantasies."<sup>2</sup> To the extent that we treat engineers' career trajectories as differentially accessible opportunities rather than meritocratic products of individual competencies and preferences, we position ourselves well to understand and dismantle persistent inequities in the profession.*

### **Introduction**

Reflect for a moment on your career path. What were your hopes, dreams, and aspirations upon graduation? Have you ever been tapped for a promotion? If so, how did this advancement opportunity shape your career trajectory? How did it support, amplify, alter, or squelch your entering aspirations? What kinds of learning opportunities did it open up? Which paths remained inaccessible? Now zoom out to the career trajectories of your colleagues. How have unexpected shoulder taps from their supervisors fortified their ambitions or sent them on a new path? Have you observed any career mobility patterns at the organizational level? We have. Our interdisciplinary engineering education research team conducted a workplace learning study and found an over-representation of white men in senior executive roles, white women in sociotechnical bridging roles, and racially minoritized men leaping from terminal technical roles to begin their own businesses.<sup>3-5</sup> How would you explain the over-representation of white, domestically trained men in senior executive roles? Is it a matter of personal choice? Competence? Industry norms? The primary purpose of our paper is to grapple with this question. We do so, not simply because it is an interesting investigative problem, but more importantly, because it may help us understand persistent inequities in the engineering profession.

After reviewing the literature on engineers' career paths, we share our critical theoretical perspective drawing on Jeannie Oakes' educational tracking research<sup>6-9</sup> and Audre Lorde's notion of "dominant fantasies."<sup>2</sup> We then read 29 senior engineers' career history narratives through this critical lens. Our intentional paradigm shift from interpretivism to critical theory enables us to supplement agentic explanations of career advancement with a systemic analysis of gendered and racialized mobility patterns. By rejecting the meritocratic explanation that an overrepresentation of white men in senior executive roles is a product of their superiority as engineering leaders, we expose an important analytical site for the examination of inequity in the engineering profession.

### **Literature Review—Engineers' Career Paths**

Over the past century, engineering education researchers have privileged teaching and learning in undergraduate engineering programs over other sites of professionally

relevant learning. When workplaces are mentioned, they are usually invoked as a destination for engineering graduates rather than as a site of learning in their own right, conflating education with formal schooling. For this reason, we supplement our review of career path research in engineering education with studies emerging from two other disciplines—human resource management and the sociology of the professions.

William K. LeBold<sup>10</sup> was the first engineering educator to study career paths in his research. Interestingly, he was also the first to disaggregate his findings by race and gender. For at least three decades beginning in the 1960s, LeBold and his team regularly surveyed Purdue University engineering graduates to highlight the recruitment and retention patterns of racially minoritized, internationally trained, and female alumni.<sup>10</sup> He found higher unemployment rates among Black, Latino, and internationally trained engineers, with Black alumni more likely to be employed full time in non-engineering areas than white alumni. Gender differences were minimal in the first ten years after graduation, but became pronounced after ten years at which point salaries were 25% higher for men than for women with similar experience. Men were also 25% more likely, at the ten-year mark, to be promoted to senior managerial roles than their female peers. Finally, white men expressed the highest levels of job satisfaction and Black and female graduates leaned more toward pursuing graduate education than their peers. More recently, Sheri Sheppard's large-scale school to work transition surveys have put career path analysis on the engineering education research map.<sup>11</sup> Briefly, Sheppard and her team used two large data sets—the Academic Pathways of People Learning Engineering Survey (APPLES), and the National Survey of Recent College Graduates (NSRCG)—to examine the school to work transition. They found that while many engineering students were open to a wide range of career prospects prior to graduation, most ended up working in traditional engineering roles shortly after graduating. This finding documents the narrowing of occupational prospects, but fails to provide insights on retention.

Outside the field of engineering education, the earliest career path research featuring engineers' work built on a dual track model attributed to human resource managers in the 1950s. This body of literature suggests that managers of large technical firms were motivated to institutionalize a technical incentive structure to improve the retention of high performing engineers. Adherents to the dual track model proposed that engineers could either: 1) ascend a traditional management hierarchy, gaining authority over larger numbers of employees with each step, or 2) move through successive technical titles associated with salary increases, higher status, greater responsibility, and increased autonomy.<sup>12, 13</sup> Unfortunately, without accounting for differential mobility patterns on the two paths, research building on this managerial model frames engineers' career trajectories as a product of personal preference for one of two mutually exclusive paths.

Goldner and Ritti's analytic contribution to the dual track model is to position the two ladders as a sociological phenomenon worthy of critical attention, rather than as a neutral, meritocratic incentive structure.<sup>12</sup> While the authors concede that entry-level engineers may be motivated by a technical track, their findings highlight the power differential between individuals on the two ladders. On the basis of their findings, Goldner and Ritti urge researchers to acknowledge the role of power when examining engineers' career

paths. Roberts and Biddle similarly note status discrepancies between engineers on technical and managerial tracks, with senior managers experiencing greater mobility and remuneration for their work than technical specialists.<sup>14</sup> Their examination of promotion patterns at a large manufacturing firm in the United States provides empirical backing for the presence of inequitable mobility patterns within the engineering profession. Both studies reveal structural inequities afforded to engineers on managerial and technical tracks, but they do little to transcend the dual track assumption.

More recently, a small but growing body of literature has begun to highlight a wider range of workplace realities for engineers. Tremblay and his colleagues surveyed 900 engineers in Quebec in the early 2000s and found multiple, divergent career paths—technical, managerial, project-based, hybrid and entrepreneurial.<sup>15</sup> Their discriminant analysis revealed inequities along these five differentiated trajectories. In particular, compared to engineers on the two traditional paths, Tremblay et al found that project managers and those on hybrid paths quickly reached a pay plateau. Their analysis was inconclusive for entrepreneurs, but another study conducted by Solymossy and Gross suggests that engineers may become entrepreneurs to capture the potential value of their intellectual property.<sup>16</sup> Finally, Hodgson and his colleagues examined the experiences of project managers in England and Scotland and found a gap between corporate promises of upward mobility and the experiences of project managers who had limited authority, increased administrative responsibility, and a relative loss of technical status.<sup>17</sup> Taken together, these three studies indicate that engineers on the two paths privileged by the dual track model enjoy a level of visibility, professional autonomy, mobility and decision-making authority rarely accorded to project managers, hybrid professionals, and terminal middle managers, thereby challenging the dual track model and revealing the differential reward system afforded to engineers on a diversity of paths. Unfortunately, they remain silent on gender, race and other dimensions of demographic diversity.

Over the past decade, researchers committed to fostering equity, diversity, and inclusion (EDI) in engineering have begun tracking the gendered nature of career advancement in the profession. In 2016, Cardador published a survey of 274 industry-based engineers in the United States and found that female engineers on a managerial path were at greater risk of professional attrition than their colleagues on other paths.<sup>18</sup> Increasing female engineers' access to management had unintended consequences for the women on these paths who reported feeling less like real engineers, working longer hours with less flexibility than female counterparts in technical roles.<sup>19</sup> Her findings add a layer of analytic complexity to Goldner and Ritti's claim from the mid 1960s that engineers on a managerial track have greater status, power and decision-making authority than those on a technical track. Similarly, Faulkner's ethnographic study of five engineering workplaces adds another layer of analytic complexity to the technical/managerial comparison by suggesting that professional engineers may be fortifying a "nuts and bolts" professional identity, restricting access to professional identification and belonging among engineers who pursue a managerial path.<sup>20</sup>

Cardador's and Faulkner's studies highlight the heterogeneity of managerial paths in engineering which may or may not have been present five decades earlier when Goldner

and Ritti conducted their study. In particular, engineers who were promoted to team management roles in Faulkner and Cardador's studies lost their proximity to technical insider status, without gaining the managerial authority extended to mostly male colleagues in senior line management roles. As women have entered the engineering workforce in greater numbers and ascended the managerial hierarchy, the association between management and upward mobility may have shifted, reifying a sociotechnical dualism in the profession equating some forms of managerial mobility with exit. This explanation is supported by Fouad's finding that 75% of women who left engineering were on a managerial path,<sup>21</sup> and Marinelli and Lord's finding that female engineering managers were overwhelmingly on terminal paths leading to middle rather than senior management.<sup>22</sup> Making matters worse, many of the women were called to lead during times of organizational transition, crisis or instability, resulting in poor working conditions. Related to our current line of analysis on career stratification, any career path that transitions a young technical employee into a high intensity, high-risk middle management role has inequity structured into it. To the extent that more women are tapped for these roles than men, the inequity is gendered.

As demonstrated by LeBold more than five decades ago, systemic inequity in the engineering profession is also racialized, but very few career path researchers have disaggregated engineers' career mobility by race. Adams is an exception to this trend. In a sociological study comparing the career paths of engineering and nursing graduates in Ontario, Canada, she found that engineers who were internationally trained, female and/or racially minoritized reported poorer working conditions and more restricted mobility than their white, male, Canadian educated counterparts.<sup>23, 24</sup> Her study provides important evidence to support the claim that engineers' career mobility and working conditions reflect existing socio-political disparities in the province.

Our literature review highlights three critical dimensions of engineering career path research. First, administrative decisions do not reflect the full range of human experience. In more concrete terms, we cannot assume that engineers' lived realities will conform to the dual track model proposed by human resource managers. Second, not all career paths are made equal. It behooves us, as critical engineering education researchers, to examine the full range of mobility patterns, working conditions and structural features inherent to each path. Finally, not all career paths are equally accessible. For this reason, we must ask which engineering graduates are advantaged and disadvantaged by career path stratification. By addressing these three key insights drawn from the literature on engineers' career paths, our critical analysis of 29 senior engineers' career history interviews has the potential to reveal and dismantle one type of systemic inequity structured into the engineering profession—career path stratification.

### **Paradigm Shift: What can we Accomplish by Centering Critical Theory?**

In this paper, we<sup>1</sup> switch from the social constructivist approach of our previous work to one more aligned with critical theory, where our main objective is to explicate structural

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<sup>1</sup> Our paradigmatically heterogeneous, interdisciplinary, multi-generational research team is made up of three engineering educators, two social science researchers, and a doctoral engineering education student. Related to the demographic groups we discuss in this paper, 4/6 of us are white, 4/6 of us are female, and

inequity.<sup>25, 26</sup> By reading participants' narratives through a critical lens, we bring additional meaning to their stories. We adopt a critical approach for three reasons: first because it is the entering paradigm for three out of six members of our research team, second because it authorizes us to elevate social structure over human agency as an explanation for inequitable mobility patterns in the profession, and third because it allows us to explain systemic inequities that may not be discernable to participants. At its core, our analysis is a critical sense making project that enables us to break through dominant discourses framing recruitment and retention as the EDI problem to solve. It is not enough to describe underrepresentation or share engineers' interpretations of their own career paths. Engineering education researchers have been doing both of these things for decades. Rather, we must supplement this important work by unearthing root causes of inequity in the profession. We cannot do this without a paradigm shift.

### **Theoretical Lens: Reproducing Dominant Fantasies through Career Stratification**

Our theoretical lens draws on Audre Lorde's powerful invocation of systemic inequity as the product of dominant fantasies<sup>2</sup> and Jeannie Oakes' formative work on tracking in secondary schools.<sup>6-8</sup> We begin with Lorde:

*As a Black lesbian mother in an interracial marriage, there was usually some part of me guaranteed to offend everybody's comfortable prejudices of who I should be. That is how I learned that if I didn't define myself for myself, I would be **crunched into other people's fantasies for me** and eaten alive. My poetry, my life, my work, my energies for struggle were not acceptable unless I pretended to match somebody else's norm. I learned that not only couldn't I succeed at that game, but the energy needed for that masquerade would be lost to my work. (Lorde, 1982, p.4-5)*

In this paper, we draw on Lorde's notion of dominant fantasies to trace the ways in which social norms are translated into engineers' career paths.<sup>2</sup> In particular, we argue that career stratification through shoulder tapping is a prevalent vehicle for the realization of dominant fantasies. Without characterizing promotion patterns in this way, and acknowledging that executive fantasies for success may be simultaneously seductive and destructive, we may accept the powerful myth that we live, work and learn in a meritocracy. Two key features of Lorde's work drive our analysis:

- *Reification of societal norms*: How may executive fantasies of engineering success propagate white supremacist, patriarchal norms in the profession?
- *Uneven consequences of fit*: Who is crunched into these normative fantasies? Who is uplifted by them? For whom does advancement require a masquerade?

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all 6 of us completed our undergraduate education in Canada. We have different levels of familiarity and comfort with critical theory. The process of writing and integrating feedback has itself been an important learning process for all of us, helping us bridge our own paradigmatic comfort zones.

<sup>2</sup> One reviewer invited us to justify our use of Lorde's theory to analyze mobility patterns, suggesting that she was referring to social roles and identities, not career paths. While we cannot claim to know Lorde's intended referent, the fantasies she names feel analytically useful to us as a manifestation of dominant norms that impact a range of social phenomena—including social roles, identities, and career paths.

Shifting from the reproduction of dominant norms and fantasies to a mechanism that may be responsible for reifying this reproductive process, we draw on the research of Jeannie Oakes, a critical education theorist studying the organizational features of secondary schools. Oakes found that the century old practice of tracking students into academic and vocational classes led to a disproportionately high percentage of economically and racially minoritized students in vocational tracks with restricted career mobility prospects. Her work exposed a clear discrepancy between the *promise* and *consequences* of educational tracking<sup>3</sup> policies.

In terms of the promise, tracking was promoted at the beginning of the 20<sup>th</sup> century as an educational reform strategy to accommodate increasing student diversity. While responding to diversity is an essential educational responsibility, Oakes' analysis demonstrated something that many parents and anti-racist community activist already knew; the practice of tracking not only failed to meet a greater diversity of student needs, but actually reified societal inequities through socioeconomic and racial segregation. The widespread practice of vocational tracking under the banner of equal opportunity allows schools to reproduce structural advantages for the children of wealthy, white families without being called out for racism. Three features of Oakes' research frame our analysis:

- *Rhetoric vs reality*: Discrepancy between administrative rhetoric (equal opportunity) and student outcomes (racial and socio-economic segregation).
- *Stratification*: The use of an educational mechanism (vocational tracking) to translate administrative promises into educational practice.
- *Reproducing inequity*: Segregation hidden under a cloak of meritocracy.

For the remainder of this paper we read 29 senior engineers' career history narratives through the following conceptual anchors drawn from Lorde's and Oakes' work:

- 1) **Stratification mechanism**: *How do engineers end up on different paths?* (Oakes)
- 2) **Rhetoric vs reality**: *How does the promise of a dual track advancement system hold up to the reality of engineers' career mobility outcomes?* (Oakes)
- 3) **Reifying inequity through normative fantasies**: *Who is uplifted by vs crunched into dominant (white supremacist, patriarchal, meritocratic) fantasies? For whom does upward mobility require a masquerade?* (Lorde)

These three sub-questions enable us to answer our central research question: How does career stratification contribute to the reification of inequity in the engineering profession?

### **Methodology: Critical analysis of Career History Interviews**

This paper is a secondary, critical analysis of findings that emerged from an earlier study examining how engineers learn to lead over the course of their careers.<sup>3-5, 27</sup> Our unit of analysis is the career path, not the individual. As such, we step back from participants' interpretations of their own experiences to critically analyze mobility patterns, career stratification mechanisms, and demographic trends across five distinct career paths that

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<sup>3</sup> Canadian readers may be unfamiliar with the term "tracking." We have a similar educational stratification practice in our secondary schools, but we refer to it as "streaming."

afford engineers differential access to organizational and professional power. We are characterizing paths as inequitable access points to career advancement, not as essential truths about the individuals or demographic groups who travel along them. This methodological approach remains on the margins of engineering education, but is well established in engineering studies research.<sup>28-42</sup> We briefly describe our data generation process for the original study to provide readers with context.

Our initial interest in engineers' workplace learning drove us to use a truncated version of life history research.<sup>43, 44</sup> Life history research builds on deeply contextualized chronological narratives about individuals' lives, enabling researchers to study human development over time without the expense and inevitable attrition rates associated with longitudinal designs. Career history research does the same, paying specific attention to an individual's period of employment.<sup>45</sup> Between March and December 2018, we conducted 29 interviews with senior engineers working in seven different industries: chemical processing, manufacturing, higher education, public service, consulting, financial services, and software. All participants had a minimum of 25 years' workplace experience, 93% were licensed Professional Engineers, and all but one worked in Canada. All 29 participants were identified by key informants as engineering leaders. Despite a deliberate attempt to demographically diversify our sample, the final group was 72% male and 79% white. Our sample is older (mean age, 59), more female, and slightly more racially minoritized than the population of licenced engineers in North America.<sup>46-48</sup> Our primary means of data generation involved semi-structured career history interviews beginning with participants' decision to study engineering. Follow up prompts elicited reflective narratives about their professional journeys, career transitions, proud moments and struggles. We audio recorded interviews with participants' permission and transcribed them verbatim, removing identifying features prior to analysis. We proceeded with the approval of our institutional research ethics board.

This paper presents a secondary critical analysis of the 29 career history narratives. We began by translating job titles and role transitions from participants' resumes and interview transcripts into five levels—1) Engineer in Training (EIT), 2) Project Manager, 3) Director, 4) Senior Executive, and 5) CEO. These conversions are imperfect and necessarily miss organizational and occupational nuances. They did, however, allow us to analyze hierarchical relations in professional organizations characterized by senior leaders as “flat.” We then recorded the number of years at each level. For advancement mechanisms, we analyzed participants' career history narratives for stories about shoulder tapping, promotions, mentorship, and sponsorship. Finally, we grouped senior engineers with similar mobility patterns into consolidated career paths and read the resulting paths through our theoretical lens.

### **Findings: Differentiated Mobility Patterns by Career Path**

Our phase one findings taught us that the 29 engineers we interviewed followed five distinct career paths. We refer to the differentiated paths as: company men, technical specialists, boundary spanners, entrepreneurs, and invisible engineers.<sup>5</sup> We briefly describe the five original paths below, then collapse them into three consolidated paths to facilitate our critical analysis of social relations in the engineering profession.



The five engineers we characterized as *company men* were highly competitive, outward facing individuals at the very top of their respective organizational hierarchies. We used the moniker “company men” to signify the seamless relationship between participants’ personal values and organizational contexts. In terms of demographics, all five engineers on this path were white men who had completed their undergraduate education in Canada. Early formative experiences for the group involved an interest in applied or practical work which many participants attributed to their working-class origins, as children of farmers, mechanics and millwrights. Company men were tapped early for stretch assignments, supported through high profile leadership opportunities, and groomed for senior leadership. At the time of the interview, all were either CEOs of large engineering firms, or recently retired senior executives.

The six engineers we refer to as *technical specialists* were driven by the desire to design complex, technically interesting projects. This group was predominantly male, but included a larger percentage of internationally trained engineers than we observed in other groups. In terms of growing up experiences, technical specialists were more likely to have lived through some kind of external political turmoil while growing up—war, massacre, or surviving large-scale economic downturn. In terms of mobility, they were reluctantly promoted into a range of supervisory and managerial roles by direct supervisors who observed them delivering on increasingly complex technical projects. At the time of the interview, most were in senior technical roles.

The five senior engineers we call *boundary spanners* were promoted to manage “people problems” early in their careers. While they were often the first in their respective cohorts to be promoted, most hit a mid-career plateau after being drawn into successive trials by fire across organizational units. Some were tapped to temporarily take the place of belligerent managers whose teams had fallen apart, others to replace business unit leaders whose projects had serious feasibility flaws, and others still, to mediate labour disputes in newly acquired plants. In terms of demographics, slightly more than half of the boundary spanners were female. All were white and all had completed their undergraduate engineering degrees in Canada. Early formative experiences as student body presidents, community organizers, or family caregivers, led the engineers on this path to view compassion as a non-negotiable feature of leadership. By the time of the interview, all boundary spanners had moved into senior integrative roles.

The six senior engineers we call *entrepreneurs* began their careers like those in the first three groups, as highly driven employees working for larger organizations, but after encountering frustrating constraints such as organizational cultures that did not align with their values, difficulty gaining access to senior leadership roles, limited prospects for wealth creation, or bureaucratic regulations restricting their capacity to innovate, they left their organizations and established start-ups or became independent consultants. In terms of demographics, the entrepreneurs were more racially diverse and internationally trained than engineers on other paths. All six entrepreneurs were men. While many of these participants described themselves as “lone wolves,” all shared formative growing up experiences with parents who modeled success, provided support, and communicated

high expectations for their children to excel. In some cases, the high expectations were received implicitly as part of an immigrant story, with participants becoming engineers to honour the sacrifices made by their parents. At the time of the interview, most entrepreneurs were CEOs of thriving businesses.

Finally, the seven participants we characterize as *invisible engineers* worked in public sector or financial service organizations. Most leveraged their technical training in these non-traditional engineering workplaces, building bridges between senior staff and the technical teams they supervised. Engineers on this path were more likely to experience a steady, predictable rise than participants employed by engineering-intensive firms. In terms of demographics, they were mostly white, mostly female, and all trained in Canada. Two of the women on this path shared stories of external hostility to their ambition, but all eventually ascended the organizational hierarchy, including three who reached the status of CEO, Senior VP, and Assistant Deputy Minister. Many described growing up in relative economic privilege, with parents who were professionals, a risk-reduction factor when considering a non-traditional path.

Analyzing the five career paths from a critical lens attentive to power and social relations, it is clear that all paths are not created equal, and that access to these paths is similarly discrepant. To examine how mobility patterns and career stratification mechanisms reflect and reify inequities in the engineering profession, we collapsed the five original paths into three imperfect groupings: *Organizationally groomed executives* (company men), *Sociotechnical managers* (boundary spanners and invisible engineers), and *Independent agents* (technical specialists and entrepreneurs).

The company men remain a distinct group. We refer to them as *organizationally groomed executives* because they were promoted over several decades within the context of a single organization. Most were tapped early to manage large, high profile projects and rose quickly to senior leadership. While one invisible engineer and a number of entrepreneurs did eventually become CEOs, the five participants in this group were groomed for senior leadership at an early stage, all but one becoming CEOs of the organizations that had hired them as EITs.

Our first composite group connects participants on boundary spanning and invisible engineering paths. We refer to the engineers on this path as *sociotechnical managers* because their work always demanded active bridging of social and technical concerns through the management of large, interdisciplinary teams. They regularly had to coordinate and balance technical problem solving with team cohesion, conflict resolution, client satisfaction, environmental sustainability, and broader societal impact. Despite this organizationally vital role, senior engineers in this group experienced a longer, flatter path to senior leadership than organizationally groomed executives. Some experienced mid-career plateaus, while others were required to apply for promotions to be recognized.

Finally, while it may seem odd to collapse entrepreneurs and technical specialists into a single group given clear discrepancies in their organizational locations and leadership affinities, the senior engineers we interviewed on these two paths shared a fiercely

independent drive. Technical specialists were loyal to internalized notions of professional integrity, while entrepreneurs were loyal to their personal values, dreams and aspirations. Both groups of engineers on this consolidated *independent agent* path were less amenable to the visions of their employers than other study participants. Please see Table one for a summary of demographic and mobility patterns across the three consolidated paths.

Table 1: Consolidated Paths Illustrating Discrepancies in Mobility Patterns

<b>Consolidated path</b>	<b>Organizationally groomed executives (n=5)</b>	<b>Sociotechnical managers (n=12)</b>	<b>Independent agents (n=12)</b>
<b>Career path(s)</b>	Company men (CM)	Boundary spanners (BS) Invisible engineers (IE)	Technical specialists (TS) Entrepreneurs (E)
<b>Demographics</b>	White (100%) Male (100%) Domestic (100%)	White (92%) Female (58%) Domestic (100%)	White (58%) Male (92%) Int'l trained (58%)
<b>Terminal position</b>	CEO	Senior Executive	Senior Tech VP (TS) Start-up → CEO (E)
<b>Years at entry level</b>	1-2	1-2 (BS), 3-4 (IE)	4-5
<b>Years to Director</b>	7-10	15-25	5-15
<b>Mobility pattern</b>	Groomed for rapid rise	Trials by fire (BS) Gradual rise (IE)	Tech ladder (TS) Barriers → Leap (E)
<b>Community of practice</b>	Senior executive team & Board	Extensive networks across organizational units	Tech specialists (TS) Lone wolves with family support & clients (E)

The three consolidated paths are not only functionally distinct and differentially rewarded, but also gendered and racialized in striking ways. Organizationally groomed executives are all white, male and domestically trained; sociotechnical managers are also predominantly white and domestically trained, but include a greater concentration of women; and independent agents are predominantly male, but include a higher concentration of internationally educated and racially minoritized engineers.

These demographic trends are not surprising. Institutional policies, practices and norms often reproduce societal patterns of privilege. For instance, the implicit equation between organizational commitment and willingness to travel overseas at a moment's notice, described by participants in large international engineering firms, favoured young single men with limited childcare responsibilities. Similarly, the overwhelmingly white, male composition of senior executive teams and advisory boards made it difficult for racially minoritized engineers of all genders and white women to demonstrate the insider status required of company men throughout the grooming process. In contrast, explicit promotion pathways and anti-discrimination policies at public sector organizations offered some protection to women and racially minoritized employees when it came to workplace harassment. In a slightly different way, entrepreneurial paths afforded racially minoritized engineers greater potential for self-determination than large engineering firms with narrow definitions of success. These institutional contrasts between engineering and non-engineering organizations suggest that organizational policies, practices and norms may be partially responsible for persistent recruitment and retention issues in the profession.

### **Discussion: The Rhetoric, Realities, and Impact of Career Track Stratification**

In order to generate a persuasive explanation for structural inequity, we must transition from describing mobility patterns to theoretically analyzing uneven power dynamics. We do so now, returning to the three conceptual anchors we derived from Lorde's and Oakes' critical analyses: vocational tracking as a stratification mechanism, administrative rhetoric vs lived realities, and the reification of inequity through normative fantasies.

#### *Stratification Mechanism: Upward Mobility by Differentiated Shoulder Tapping*

The engineers we interviewed spoke in deeply personal ways about their career trajectories, but by analyzing these paths in the aggregate we found a shared structural feature. Most participants employed by engineering organizations were promoted via shoulder tapping. Company men were tapped to manage high-profile projects; boundary spanners were tapped for successive managerial repair assignments; and technical specialists were asked to supervise technically complex projects. The two exceptions to this pattern were invisible engineers who worked in organizations with more formalized promotion processes, and entrepreneurs who faced bureaucratic hurdles in place of early career taps. Engineers on all five paths demonstrated excellence along some dimension of engineering success—organizational problem solving (CM), sociotechnical bridging (BS/IE), technical acuity (TS), and innovation (E), but they were inequitably rewarded, and in some cases penalized for this excellence. Looking across the five career paths, shoulder tapping functioned as an invisible hand shaping the career trajectories and specialized responsibilities of individual engineers. Participants' self-directed movement between paths was mostly restricted to organizational exits.

#### *Rhetoric vs Reality: Incentivized Pathways vs Managerial Tracking*

Human resource managers in the 1950s proposed the dual track model of engineering advancement as a solution to the loss of technical professionals through managerial transitions. The promise of this model lay in the addition of a secondary, technical incentive structure expected to improve the organizational retention and professional identification of high performing engineers. Our analysis reveals four cracks in the dual track promise: first, there are more than two managerial paths for engineers; second, technical and managerial ladders are not equally rewarded or incentivized; third, professional identity cannot be offered by employers as a human resource benefit; and fourth, promotion patterns are rarely driven by engineering employees selecting their preferred path.

Participants on each path experienced differentiated advancement opportunities and professional identification levels. Those on a fast track company man path were groomed for rapid rise, often expressing a strong engineering identity fortified by a robust sense of organizational belonging. In short, they did not have to relinquish their technical identification in exchange for upward mobility. Technical specialists described similarly strong professional identities, but tended to advance more slowly up a shorter ladder, demonstrating that dual track parity is more rhetoric than reality. Shifting now to the three paths left unnamed by the dual track model: boundary spanners expressed strong professional identification and organizational belonging, but were disadvantaged by

successive lateral moves; entrepreneurs expressed variable levels of professional identification and remained on the periphery of organizational advancement before leaping out on their own; and invisible engineers progressed gradually up a ladder with many rungs, often struggling to claim professional belonging.

Stated simply, organizational structure plays a greater role in engineers' career mobility and sense of professional belonging, but a smaller role in their professional identification than one may predict from the dual track solution to retention. Even more relevant to our analysis of persistent inequity, career mobility on the five paths played out on an uneven terrain. While none of the entrepreneurs or invisible engineers regretted their decisions to leap from traditional engineering organizations or work in non-traditional sectors, there are professional licensing consequences for individuals who leave engineering workplaces prior to the end of their EIT period. The overrepresentation of female and racially minoritized engineers on entrepreneurial and invisible engineering paths provides us with an important insight about retention. It is possible that they are not actually leaving the profession. Instead, they may be forging new paths after being penalized or insufficiently rewarded for their service. They are trailblazers, not drop outs.

#### *Casting Roles: Reifying Inequity through Normative Fantasies*

Our findings suggest that shoulder tapping is an important vehicle for advancement in the engineering profession. Up to this point, we have characterized it in a mechanistic way, but shoulder tapping is not carried out by a machine. Rather, individuals in supervisory roles who have embraced organizational values and norms are empowered to drive professional advancement. Using Lorde's powerful language, how can we understand the fantasies of these casting agents? Are they displays of life, adventure, and uncertainty like the many children's books celebrating human potential? Can we be anybody we want to be<sup>4</sup>? Our optimistic answer to this question is, yes, we hope so, and we would like to put supports in place to make it happen, for everybody. At the moment, however, our critical analysis of 29 career history interviews with senior engineers suggests another metaphor; a well-oiled machine. Company men were tapped to promote and sell the machine, technical specialists were tapped to keep it running, and boundary spanners were tapped to lead periodic repair efforts. This mechanistic metaphor is not neutral. It is gendered and racialized, reflecting white, male, profit-driven fantasies of success.

While our purposive sampling strategy prevents us from generalizing our findings to the engineering profession, it is difficult to imagine that the percentage of white, Canadian-trained engineers on the three consolidated paths occurred by purely chance—100% for organizationally groomed executives, 94% for sociotechnical managers, and 38% for independent agents. It is similarly difficult to imagine that the percentage of men on the three paths occurred purely by chance—100% for organizationally groomed executives, 42% for sociotechnical managers, and 92% for independent agents. These stark demographic patterns raise three key questions: Why are racially minoritized and internationally-trained engineers over-represented in the two independent agent paths?

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<sup>4</sup> This is a reference to Fred Small's lullaby "Everything Possible."

Why are women over-represented in the two support paths? And where are the racially minoritized women?

To answer the first question, we return to Lorde's instructive insight about fantasies and fit. Perhaps it is less comfortable for engineers on a technical specialist or entrepreneurial path to be swept up by the managerial fantasies of their largely white, male executive teams. Technical specialists, many of whom were trained in China or Eastern Europe, may have felt excluded from Canadian engineering culture, holding on to the promise of high status technical paths they observed in their home countries. Entrepreneurs, all but one of whom were either racially minoritized or born outside of Canada, may have found themselves peripheral to white male fantasies of success, choosing instead to find another way forward for self-preservation and advancement. In most cases, their leaps functioned as liberating alternatives to professional stagnation. Still, leaving liberating leaps aside, the overrepresentation of racially minoritized men on an entrepreneurial path carries risks for professional retention, especially in the current economic context when engineering graduates with innovative ideas are encouraged to establish start-ups prior to becoming licensed. The increasing prevalence of these leaps may provide us with important insights about the failure of the engineering profession to recruit racially minoritized engineers.

To answer the second question, women may be overrepresented in the two paths blending sociotechnical service because of gender-role stereotypes about leadership and the deeply gendered nature of these paths. Eagly and Karau's role incongruity theory is instructive here.<sup>49</sup> To rehearse their argument, strong leaders are framed as agentic rather than socially responsive in western societies, negatively impacting the career mobility of collaborative engineers of all sexes.<sup>49</sup> Compounding this problem, women are often penalized for acting in ways that conflict with gender-role stereotypes, leaving female engineers who behave in agentic ways open to criticism for being too aggressive. To the extent that these stereotypes shape the shoulder-tapping and role casting tendencies of executive teams in engineering intensive organizations, women are most likely to be tracked into senior leadership when they behave in ways that are socially responsive. Those who embody a more confrontational leadership style may be overlooked twice—first because they fail to match the white, male CEO prototype, and second, because they are viewed as insufficiently relational to productively manage conflict.

Eagly and Karau's theory is analytically useful so long as we apply it to the fantasies of shoulder tappers and not to those being tapped. None of the engineers on the composite sociotechnical manager path lacked competitive drive or ambition. As such, we cannot assume they lacked agentic leadership tendencies. Rather, our findings suggest that they were streamed into support roles because executive teams benefited from their additional interpersonal competencies. Stated differently, while many engineers blend responsive and agentic leadership, career stratification practices in engineering organizations may reproduce the dualistic and essentialist western fallacy that agentic, competitive leadership cannot coexist with collaborative, empathic leadership. Focusing specifically on the women in this composite group, occupational tracking through shoulder tapping may restrict the mobility of female engineers, pushing them to privilege whatever support tendencies they may have. Those who are tapped for and accept successive support roles

may end up with limited opportunities to developed their agentic capacities, while those who refuse to be crunched into white male fantasies about supportive women may face demotion or forced exit. Both groups of female engineers (as well as socially responsive engineers of all genders) experience a more arduous, taxing leadership development path than company men groomed for executive roles. Their experiences provide us with important insights about persistent gender inequity in engineering.

Finally, and most problematically, the notable absence of racially minoritized women in our sample raises questions about compounding systems of inequity. Despite a deliberate attempt on our part to diversify our sample, we only interviewed one racialized woman, a senior engineer who chose the pseudonym “Donna.” All other female engineers were white and all other racially minoritized engineers were men. We highlight Donna’s experience, not to serve as a proxy for all racialized female engineers, but rather to magnify an important and largely obscured narrative. Donna leapt out of her constraining technical organization for reasons tied to self-preservation and safety. In particular, she began a new career in the financial sector to escape a toxic relationship with her supervisor at a traditional engineering organization. She did so at great personal and professional cost, leaving behind more than a decade of leadership experience as a licensed engineer in her chosen discipline. As engineering educators working with growing numbers of racially minoritized female students who have encountered chilly or openly hostile climates during their internship and co-op placements, we know Donna’s story is not unique. Her experience behooves us, as engineering education researchers, to examine and promote career advancement opportunities for individuals whose lived experiences diverge from the white, male, profit driven fantasy of engineering success. Until then, minoritized engineers across demographic groups will continue to bear the professionally imposed burden of identity masking, code-switching, and draining emotional labour in exchange for professional status, inclusion, and self-preservation.

### **Conclusions, Implications, and Next Steps**

We began this investigation of persistent inequity in the engineering profession by highlighting the ubiquitous yet largely overlooked phenomenon of career stratification. Company men, all of whom were white and male, experienced the most direct path to the top of their respective organizational hierarchies. In contrast, two composite groups with greater female and non-white or internationally trained representation—sociotechnical managers and independent agents—hit advancement ceilings by mid-career. This differentiated tracking system was not a product of perceived incompetence. In fact, engineers tapped for the latter two paths were often recognized for their strong leadership skills. Sociotechnical managers were lauded for excellent interpersonal and conflict management skills while entrepreneurs on the independent agent path were known for their innovative ideas and business acumen. Unfortunately, sociotechnical managers working in engineering intensive organizations were inadvertently penalized and entrepreneurs insufficiently rewarded for this excellence. Boundary spanners were assigned successive “trials by fire” slowing their rise to senior leadership, while entrepreneurs had to build their own organizations from scratch to exercise their visionary ideas. If the demographic trends in our small, unrepresentative sample reflect

patterns of privilege in the larger population of engineers, career track stratification may help explain the persistence of gender and racial inequity in the profession.

An important next step for us as engineering educators involves amplifying the voices and experiences of engineering graduates from under-represented groups who travel “against the grain”<sup>50</sup> of dominant engineering culture. Engineering graduates have been forging their own paths, often beyond the bounds of professional licensure, for decades. This is not simply a recruitment or retention problem. Our critical analysis of 29 senior engineers’ career history narratives suggests that structural barriers differentially impede the advancement and self-expression of engineers whose experiences diverge from historic patterns of privilege in the profession. We must work alongside professional regulatory bodies to legitimize the experiences of these trailblazers so that they are not forced to forfeit professional belonging in exchange for career mobility or authenticity.

When it comes to research, we need more work that takes intersectionality seriously, supporting the advancement and belonging of racially minoritized female engineers who have resisted, and in some cases re-written white male fantasies of success. Additionally, as engineering educators with industry partners committed to the leadership development of their employees, it behoves us to make this conversation relevant to human resource managers, supervisors and executive teams with the power to educate, support, mentor and diversify the next generation of engineers. While we are not in a position to share a laundry list of recommendations for industry, we have distilled three key lessons from our analysis. First, informal shoulder tapping may keep the machine running at the expense of inequitable stratification. Second, companies that publish organizational maps, paths for promotion, and anti-discrimination policies may have greater success attracting and retaining underrepresented groups of engineers. Finally, intentional de-tracking initiatives that formalize movement between paths may result in greater organizational integration, innovation, and professional satisfaction than specialized promotion ladders. These lessons will take time to implement in enduring and responsive ways, but they are not prohibitive. In the meantime, we must be honest about the distance between meritocratic rhetoric and inequitable realities. No more lullabies without action.

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